

WHAT IS CLAIMED

1. A solenoid-actuated valve assembly comprising:
a solenoid coil adapted to generate a magnetic field, and having a longitudinal axis and a bore coaxial therewith;
5 an axially movable armature of magnetic material, supported within an armature cavity for axial translation along said longitudinal axis;
a magnetic pole piece disposed within the bore of said solenoid coil and being magnetically coupled with
10 said axially movable armature;
a valve unit, mechanically coupled with said axially movable armature, and having a fluid cavity coupled in fluid communication with a fluid inlet port to which fluid is applied at a first fluid pressure, and a fluid
15 exit port from which said fluid is output at a second fluid pressure, and containing a valve seat therebetween, which is adapted to be closed by a valve closing assembly that includes a valve poppet coupled with said moveable magnetic armature, so as to regulate fluid flow between
20 said fluid inlet port and said fluid exit ports; and
a fluid pressure balancing arrangement adapted to compensate for said first and second fluid pressures being exerted against said valve poppet, and comprising a fluid flow restriction between said armature cavity and
25 said fluid cavity, and a fluid communication path through said valve closing assembly and providing fluid communication between said fluid exit port and said

armature cavity.

2. The solenoid-actuated valve assembly according to claim 1, wherein said fluid flow restriction comprises a generally annular-shaped passageway adjacent to said valve closing assembly and extending between said
5 armature cavity and said fluid cavity.

3. The solenoid-actuated valve assembly according to claim 1, wherein said fluid flow restriction comprises a fluid seal element, coupled between said valve closing assembly and said valve unit in a manner that prevents
5 fluid communication between said inlet port and said armature cavity.

4. The solenoid-actuated valve assembly according to claim 3, wherein said fluid seal element comprises a diaphragm.

5. The solenoid-actuated valve assembly according to claim 3, wherein said fluid seal element comprises an O-ring.

6. The solenoid-actuated valve assembly according to claim 1, wherein said magnetic pole piece includes
a first, generally axial portion having an end thereof axially spaced apart from and magnetically
5 coupled with said axially movable armature,

a second, generally annular portion continuous with said first, generally axial portion of said magnetic pole piece and being spaced apart from said end thereof, and

10 a third, generally radial portion continuous with said second, generally annular portion, and being magnetically coupled with said axially moveable armature;

7. The solenoid-actuated valve assembly according to claim 6, wherein said third, generally radial portion of said magnetic pole piece is solid with a housing for said solenoid coil, so that support for and axial
5 alignment of first portion of said magnetic pole piece relative to said axially moveable armature is provided by said second and third portions of said magnetic pole piece continuous therewith, and is exclusive of a non-magnetic element.

8. The solenoid-actuated valve assembly according to claim 7, wherein said second and third portions of said magnetic pole piece are configured to form, with said housing, a generally annular space that receives a
5 portion of said solenoid coil.

9. The solenoid-actuated valve assembly according to claim 6, wherein said third portion of said magnetic pole piece includes a radially inwardly projecting portion that is adjacent to but radially spaced apart

5 from and magnetically coupled with said axially moveable armature.

10. The solenoid-actuated valve assembly according to claim 6, wherein said third, generally radial portion of said magnetic pole piece is attached to said valve unit.

11. The solenoid-actuated valve assembly according to claim 6, wherein said first and second portions of said magnetic pole piece are configured to be relatively axially adjustable.

12. The solenoid-actuated valve assembly according to claim 6, wherein said second and third portions of said magnetic pole piece are separate portions of the same pole piece element.

13. The solenoid-actuated valve assembly according to claim 11, wherein said first and second portions of said magnetic pole piece are provided with a fluid seal therebetween.

14. The solenoid-actuated valve assembly according to claim 6, wherein said magnetic pole piece is configured to form a magnetic flux shunt path with said axially moveable armature.

15. The solenoid-actuated valve assembly according to claim 1, wherein said axially moveable armature is spring-supported outside said bore for axial translation relative to said magnetic pole piece.

16. A solenoid-actuated valve assembly comprising a a solenoid coil having a longitudinal axis and a solenoid cavity coaxial therewith, said solenoid coil producing a magnetic field, a magnetic pole piece
5 including an axial portion thereof supported within said solenoid cavity exclusive of the use of non-magnetic material, and an armature axially translatable relative to and axially and radially magnetically coupled with said magnetic pole piece, while being supported with said
10 magnetic pole piece by a fluid flow restriction that restricts fluid flow with said solenoid cavity and having an internal bore therethrough providing fluid communication with said solenoid cavity.

17. The solenoid-actuated valve assembly according to claim 16, further including a valve unit, mechanically coupled with said armature, and having a fluid cavity coupled in fluid communication with a fluid inlet port to
5 which fluid is applied at a first fluid pressure, and a fluid exit port from which said fluid is output at a second fluid pressure, and containing a valve seat therebetween, which is adapted to be closed by a valve closing assembly that includes a valve poppet coupled

10 with said moveable magnetic armature, so as to regulate
fluid flow between said fluid inlet port and said fluid
exit ports, and wherein said fluid flow restriction is
configured to balance fluid pressures at the fluid inlet
and exit ports applied to the opposite sides of said
15 fluid flow restriction, in a manner that is complementary
to the fluid pressures applied to opposite sides of said
valve poppet, thereby effectively neutralizing the
effects of fluid pressure on poppet position.

18. The solenoid-actuated valve assembly according
to claim 17, wherein said fluid flow restriction
comprises a generally annular-shaped passageway adjacent
to said valve closing assembly and extending between said
5 armature cavity and said fluid cavity.

19. The solenoid-actuated valve assembly according
to claim 17, wherein said fluid flow restriction
comprises a fluid seal element.

20. The solenoid-actuated valve assembly according
to claim 19, wherein said fluid seal element comprises
one of a diaphragm and an O-ring.